

## CLAIMS

1. A method for controlling a switch comprising:
  - a number of input ports, each receiving data cells on a respective link;
  - 5 a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;
  - a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:
    - 10 monitoring the remaining available buffer space AS of the shared buffer;
    - estimating the expected total content LE of the links;
    - calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;
    - 15 if the free margin sinks below a threshold  $AS-LE < A$ , then a selected link is paused;
    - if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link is un-paused.
2. A method according to claim 1, wherein the flow control means
  - 20 comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link.
3. A method according to claim 2, wherein the content LE of the links is estimated as the sum of the contents of all the input links.
- 25 4. A method according to claim 3, wherein the estimation of the content LE of the links takes into account the different link lengths and bit rates.
5. A method according to claim 4, wherein each link estimate is based on a model of the behaviour of each port.
6. A method according to claim 5, wherein the model consists of a curve
  - 30 having different segments, each segment reflecting a specific state of the port.
7. A method according to claim 6, wherein the states include:
  - a state in which the link is full and contains a maximum amount of data;
  - a state in which the port is to be paused and is waiting for a pause frame
    - 35 to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;
    - a state in which a pause frame is sent and the port is waiting for a fixed duration to allow a packet to leave the sender, and in which the link remains at the maximum amount;

a state in which the port is to be un-paused and is waiting for an un-pause frame to be sent and in which the link remains constant for a fixed duration;

a state in which an un-pause frame is sent and the link content is increased linearly with time to the maximum amount.

10      9.      A method according to claim 7, wherein the minimum amount of data equals one full-sized packet.

11. A method according to claim 2, wherein the most offending sender is  
15 paused first.

13. A method according to claim 11 or 12, wherein offending senders are detected by means of an overflow sum counter OFS.

15. A method according to claim 14, wherein the counter OFS of each input  
 . port is increased with the packet length, each time the input port sends a packet to a  
 25 congested output port.

17. A method according to claim 14, wherein an output port is considered congested if the queue length thereof exceeds a threshold.

19. A method according to claim 13, wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, all counters are divided by 2.

21. A method according to claim 13, wherein all the OFS counters are decreased linearly with time.

a state in which the port is to be paused and is waiting for a pause frame to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;

a state in which the pause frame has reached the sender and the link content is decreased linearly with time to a minimum amount:

a state in which an un-pause frame is sent and the link content is  
10 increased linearly with time to the maximum amount.

33. A switch according to claim 31, wherein the minimum amount of data equals one full-sized packet.

35. A switch according to claim 26, wherein the flow control means is arranged to pause the most offending sender first.

37. A switch according to claim 35 or 36, wherein the flow control means contain an overflow sum counter OFS to detect offending senders.

39. A switch according to claim 38, wherein the counter OFS of each input port is increased with the packet length, each time the input port sends a packet to a congested output port.

41. A switch according to claim 38, wherein an output port is considered congested if the queue length thereof exceeds a threshold.

35      43.      A switch according to claim 37, wherein a maximum value is defined for  
the OFS counters, and when one counter reaches this maximum, all counters are  
divided by 2.

44. A switch according to claim 37, wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, the value of the

45. A switch according to claim 37, wherein all the OFS counters are decreased linearly with time.

47. A switch according to claim 25, wherein the threshold A is set to a negative value ( $A < 0$ ).

48. A switch according to claim 25, wherein the threshold A is less than or equal to the threshold B ( $A \leq B$ ).